Expanding M NET: Lessons from the Development of a Referring Physician Computer Network

Jocelyn G. DeWitt, Ph. D.*, Kurt A. Riegel, ** Michael P. Miotto,**
*University of Michigan Medical Center
**International Business Machines, Inc.

ABSTRACT

M NET, the University of Michigan Medical Center's statewide referring physician computer network, was implemented as a pilot project in 1990. After three years of design, development and implementation, M NET has progressed from its pilot project status to a production system within the institution's strategic plan for hospital networking.

This paper describes the evolution of M NET from a small pilot project to its current production status encompassing all clinical departments and hundreds of physicians across the state. The lessons learned from the pilot, the requirements of both the referring physicians and the Medical Center, and the development of a flexible and robust network architecture to allow network expansion are addressed.

INTRODUCTION

The need for efficient, reliable and easy access to hospital and clinical information by referring physicians has been well documented in the literature.[1,2,3,4] Numerous implementation strategies for various computer and telephone based information systems have been described.[5,6] Many hospitals view this provision of information access as key to maintaining a referral base, establishing new referral source relationships, and, now with health care reform issues at the forefront, providing a service that differentiates them from competitor hospitals hoping to establish referral relationships with the same audience. Concurrently, these information services must be cost effective in their approach and in the rationale for their implementation.

Similarly, referring physicians view information access as being crucial to providing high quality follow-up care to patients referred to tertiary institutions. They often find that this information access allows them to provide ongoing quality care in remote locations through literature search capabilities, consultant resources using electronic mail and other means, and bulletin board functions alerting them to health care news of particular interest to them. Referring physicians are looking for ways to provide high quality, yet cost-effective health care and see easily accessible information as critical to that endeavor.

The University of Michigan Medical Center (UMMC) launched its own referring physician computer network in 1990 after several years of requirements gathering and institutional preparation.[7] This pilot project, developed in conjunction with IBM, spanned three years until the fall of 1993, when the full production implementation of M NET began. This paper describes the transformation of M NET from a pilot project to its current production status. The lessons learned from the pilot, the requirements of the referring physicians and the UMMC, and the implementation of an architecture to allow for network expansion are addressed.

PILOT IMPLEMENTATION

As a referring physician computer network, M NET's primary purpose was to facilitate the dissemination of information from the University of Michigan Medical Center to its referring physicians across the state. The information disseminated included clinical records, such as discharge summaries and procedural reports; CME course information; general information on Medical Center departments and services; a restaurant, shopping and lodging guide; maps and directions to the Medical Center; and functional capabilities such as electronic mail and Medline access. A graphical user interface was designed for easy retrieval of the available information. Computer workstations consisting of an IBM PS/2 Model 70, an IBM 4019 LaserPrinter, a U.S. Robotic Courier V.32 bis modem, and an IBM 8515 XGA high resolution monitor were loaned to the participating referring physicians during the pilot project. Twenty sites across the state encompassing 45 physicians comprised the external pilot network participants. Adult and pediatric cardiology were the two internal hospital pilot departments.

In order to accommodate the complexity of the UMMC hospital-wide information system and plans for substantial network growth, the initial M NET network architecture was designed for change and expansion. Rather than building M NET-specific

function into existing departmental systems or the hospital mainframe, a three-level approach was used. This approach called for a dedicated server to be placed between the hospital data sources and the external referring physician machines, allowing for improved flexibility and control of network function. The pilot network architecture that resulted from these considerations is shown in Figure 1.

The hospital mainframe electronic mail system served as the initial collection point for reports sent to referring physicians from clinical departments. The M NET server was an IBM PS/2 model 80 running OS/2. This machine would transfer reports from the mainframe and distribute them to local mailboxes for each referring physician. M NET client machines running a custom-built user interface would then dial into the M NET server and retrieve patient reports, electronic mail, and other data.

Subsequently, the M NET project has been elevated to a production system within the Medical Center's information system initiatives. All clinical departments are now able to participate in M NET by providing the clinical information pertinent to the patients sent by their referring physicians. Additionally, all referring physicians across the state may now become M NET participants, resulting in an ever increasing number of network users.

The following sections discuss the lessons learned from the pilot project and the strategies that were implemented as a result of those lessons.

LESSONS LEARNED

At the end of three years of pilot implementation, data collection and requirements gathering, it was learned that, in general:

1. A large percentage of referring physician offices do not have computer systems to run their practices. Most common is the use of a personal computer or terminal used solely to access a contract billing service.

2. Most referring physicians are not yet comfortable using computers to manage their patient data and do not have online practice management systems in their offices. Therefore, they still prefer paper copies of information to include in their patient files.

3. Physicians are not the primary users of the computer. Office staff and nurses are more likely to be the daily computer operators. Physicians use the computer for specific functions such as electronic mail and literature searches.

4. Providing a computer to a referring physician is not sufficient impetus for a physician to use the computer, especially if the computer is able to receive information from only one institution. Similarly, a referring physician will not
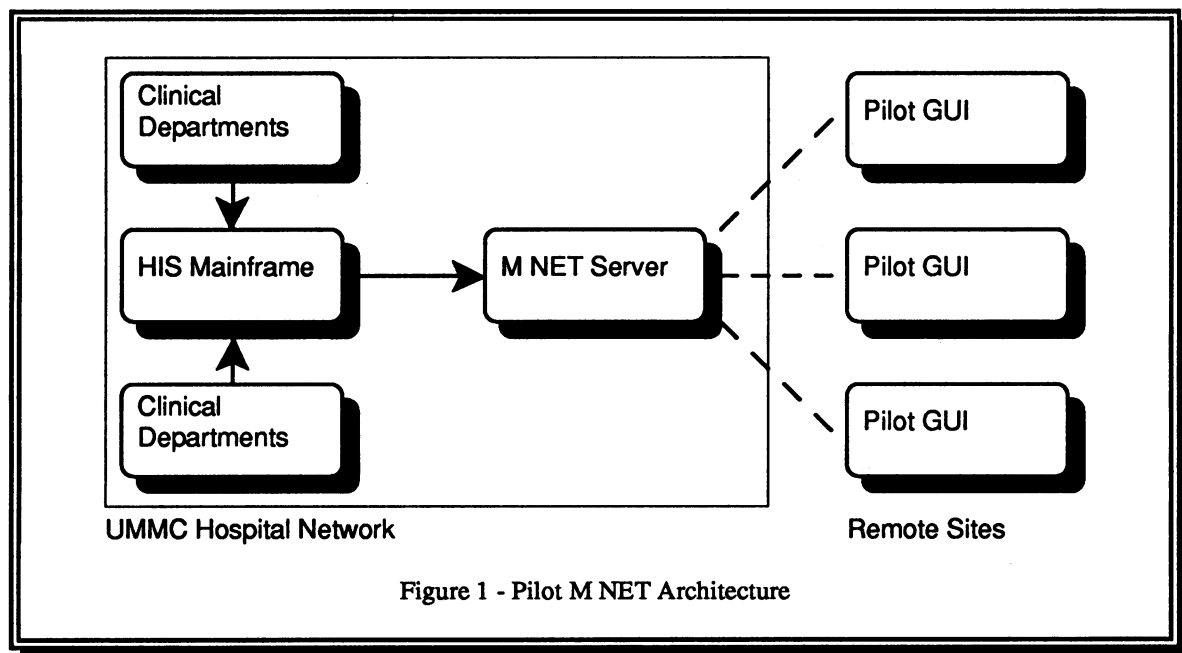

Figure 1 - Pilot M NET Architecture

purchase a computer to access a single institution's information.

5. Referring physicians are most interested in receiving clinical information regarding their patients as quickly as possible. Complementary data, such as CME course information, restaurant and lodging information, and Medical Center services are of less use and interest to them.

6. A referring physician computer network must provide adaptability to a variety of back end networks and data sources to allow the incorporation of all clinical data sources.

7. A referring physician computer network must also provide for the integration of a variety of front end interfaces to support the creation of a variety of delivery platforms to meet user requirements.

PROJECT STRATEGIES

Given the knowledge gained from the referring physicians who participated in the pilot project, the conceptual framework for production implementation of M NET was revised and expanded. This section describes the strategies implemented as a result of pilot project experience. These strategies will be discussed in terms of delivery options, program functions and system architecture.

Delivery Options

Originally it was determined that information would be delivered to the referring physician office via a single computer interface. While valid as a long-term strategic goal for referring physician networking, that decision became an obstacle to many of the referring physicians receiving the information they required. Without computers in their offices, and without working knowledge of and comfort with computers, it was premature to expect the physicians and office staff to embrace a single technology. Therefore, several additional options for delivering the information to the referring physicians were developed. Physicians would then be able to choose which option best met their environment and information needs. The M NET delivery options now available are: 1) M NET with the custom designed user interface designed for and used during the pilot phase of M NET; 2) M NET on Lotus Notes (a commercially available groupware software package), that runs on the Windows or Macintosh operating systems; 3) M NET integrated into a commer-

cially available office practice management system; 4) M NET by fax, which allows information to go automatically to a referring physician fax machine; and 5) M NET on DOS, a query-based program for referrers with minimal equipment availability, but who require the ability to conduct ad hoc searches for patient information.

This range of options allows the Medical Center to tailor the information system solution to the unique environment of each referring physician office. These options also allow for a dynamic office environment; as the office infrastructure becomes more sophisticated the M NET implementation scheme will change to meet that growth.

M NET on Lotus Notes has received the most development effort of the new options. Its flexibility in terms of platform, data integration, image management capability and expansion provide for significant development opportunities. Using Notes, each physician office can define and develop unique functions for its own use. Because the user interface is standard across all the functions within Notes, there is no additional training required when new functions are added. Additionally, a commercially available, standardized delivery vehicle allows the M NET staff to concentrate on information content rather than support of the application itself. Simplifying the network support requirements is of particular interest given the size of the state of Michigan and its rural geography. Once a Lotus Notes M NET site is installed and the users trained, all program updates and enhancements can be completed on line.

Purchasers of a practice management software package (Genius Solutions) are able to run M NET through a module on that package. Data sent to these offices from the UMMC flow directly into the patient database within the practice management software. M NET is available through the purchase and installation of this software package, eliminating the need for offices to run two separate systems to manage their offices and to access the UMMC.

M NET by fax has allowed offices with no computer to receive information on their patients as readily as offices with computers. Similar to most of the other M NET options, physicians in these offices do not have to request the information, as it is sent to them automatically from the M NET server.

The M NET on DOS option is specifically designed for physicians with less powerful computer systems.

However, it provides flexible capabilities that allow ad hoc queries to the Medical Center on any patient referred by that physician.

Program Function

The functions provided within each of these M NET options have also been reconsidered. Referring physicians are concerned primarily with obtaining timely and valid clinical information about their patients. In addition to this clinical information, M NET provided complementary data for patient, office staff and physician use. Much of this peripheral information was transferred to the new platforms because of high utilization during the pilot project. This information included electronic mail; library and Medline access; CME course brochures and registration functions; a catalog describing hospital departments, clinics, services and procedures; and maps and directions to the Medical Center. Information that was not accessed frequently and deemed unimportant to the referring physician was eliminated. These discontinued functions included directories of restaurants, hotels, and shopping areas; a journal club listing abstracts of selected articles by discipline; research protocols; and a list of the computer assisted instructional materials available at the Medical Center. As the referring physician

requirements change these functions will be reassessed to determine their usefulness and may be reintegrated into the M NET program in similar or revised form.

Network Architecture

Since the development of the pilot architecture, there have been numerous changes in the data sources, data access mechanisms and presentation vehicles that comprise M NET. Moreover, it has become apparent that this type of change can be expected to continue as the project continues to evolve and expand. Fortunately, the basic architectural approach of placing a middleware layer between the data sources and the delivery platforms has allowed for this kind of change. The current architecture of the M NET network is shown in Figure 2.

The M NET server, running OS/2 on an IBM PS/2 model 95, continues to act as the intermediary between the data sources and the delivery platforms. This level of software control has made it possible to accommodate relatively major changes to the network with relatively minor effort and with little or no disruption to participating departments and users.
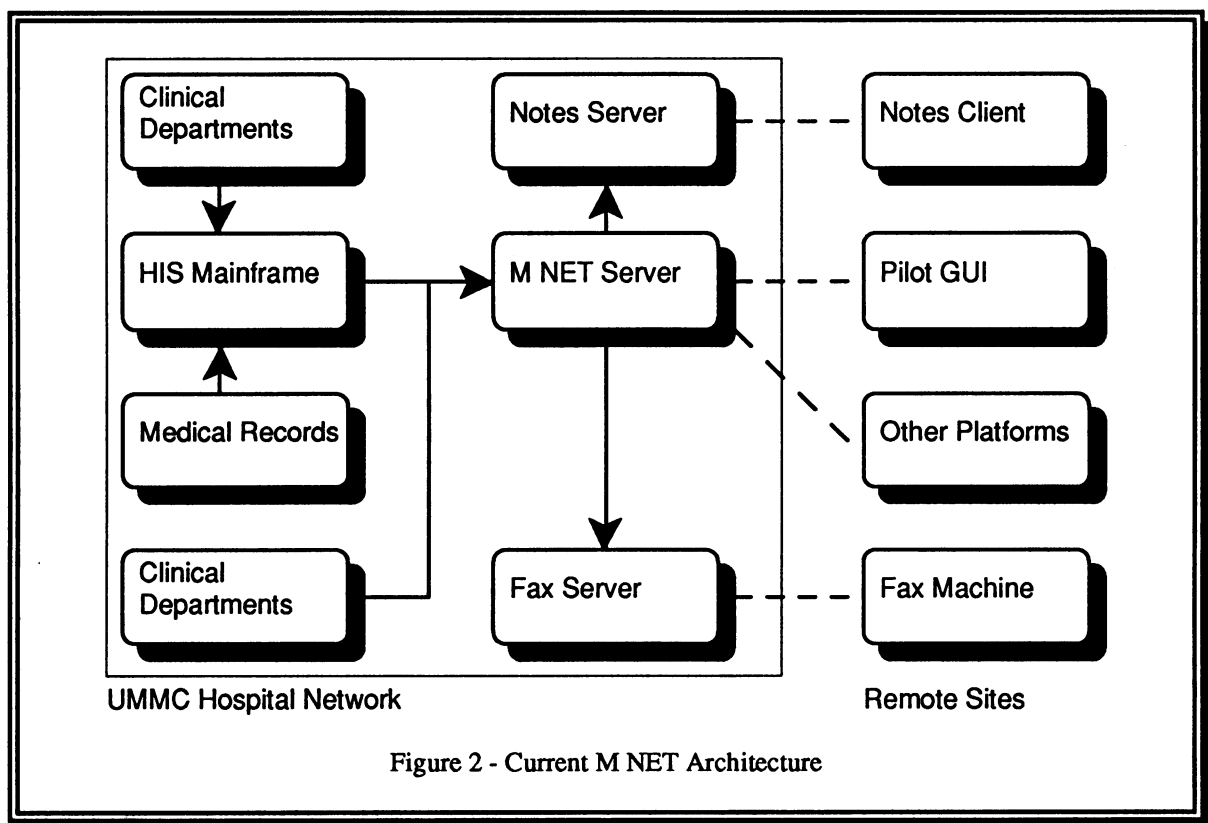

Figure 2 - Current M NET Architecture

Use of the mainframe electronic mail system has ended and been replaced with access to a VSAM database of clinical results. This database acts as a common collection point for results from clinical departments publishing their data internally. By accessing this database, M NET is able to make a substantial portion of UMMC clinical data available to outside physicians.

In addition to this central data source, several departments make their data directly available to M NET through a variety of mechanisms. Pathology and radiology data are to be published through open relational databases. Other departments send their data from extracts of proprietary databases running on a variety of platforms. Several additional types of data sources, in particular message routing systems supporting HL7, are expected to be integrated into the network within the next several months.

The variety of data delivery platforms that are now part of M NET (e.g. M NET on Lotus Notes and fax) were straightforward to incorporate into the basic three-level architecture. Additional servers were added to manage the unique characteristics of the Lotus Notes and fax platforms. These servers receive data from the M NET server through existing program interface tools, and then pass the data along to their respective client machines.

This three-level approach, incorporating data sources, delivery mechanisms, and an intermediate or middleware layer for data formatting, routing and control, has proven to be a robust, flexible, and maintainable structure for this type of physician network. In spite of the changes that have occurred in data access and end user functionality requirements as the project has moved from pilot into production stages, the network architecture has remained essentially unchanged.

CONCLUSION

The flexibility inherent within the basic network architecture as well as the functions provided by the program allow M NET to meet the continuously changing needs of the UMMC and the physicians who refer patients to the Medical Center.

Four system characteristics will help support the continued expansion of the M NET network. First, referring physicians are able to receive information through the vehicle that best meets their needs, whether that is an IBM compatible or Macintosh computer, or a fax machine. Second, the type of information the referring physician is able to receive can be tailored to meet his or her needs. Some physicians prefer to receive only clinical data, while others elect to receive a full complement of Medical Center information in addition to clinical reports. Third, as new data sources within the hospital are identified (such as new departments, new clinical procedures, or revised clinical reports), they can be integrated into the M NET network with minimal effort. And finally, the network structure will allow expansion of M NET to other referral sources, such as additional hospitals, clinics, and managed care organizations.

This paper has discussed the development of the M NET referring physician computer network and its evolution from a pilot project to a fully implemented production system. The lessons learned from this evolutionary process should assist others in the implementation of similar information networks. Clearly, a growing number of medical centers will include this type of physician network in their overall information system strategy as a means of expanding their relationships with outside referral sources and other health care providers.

References
[1]. Beck J, Krages K, Ash J, Gorman P. Outreach to Oregon Physicians and Hospitals: 5000 by 2000. Annuals New York Academy of Sciences 1992; 670:91-97.
[2]. Jacknowitz L. West Virginia CONSULT: Enhanced Information Access for Health Care Practitioners in a Rural Environment. Annuals New York Academy of Sciences 1992; 670:163-70.
[3]. McElroy T. Hospital-Physician Bonding: The Ultimate Strategy. Michigan Hospitals 1988; 9:27-9.
[4]. Parsons D. Progress and Problems of Interhospital Consulting by Computer. Annuals New York Academy of Sciences 1992; 670:1-11.
[5]. Holt N, Crawford M. Medial Information Service via Telephone: The Pioneer of Physician Consultation Services. Annuals New York Academy of Sciences 1992; 670:1-11.
[6]. Reis H, Brenner D, Robinson J. Multimedia Communications in Health Care. Annuals New York Academy of Sciences1992; 670:155-62.
[7]. Ten Haken J, Calhoun J, Ellison J, Miotto M. Proceedings of the Sixteenth Annual Symposium on Computer Applications in Medical Care. M NET: A Statewide Referring Physician Computer Network. McGraw-Hill, Inc. 1992; 814-5.